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ABSTRACT

This program guide identifies particular considerations in the organization, operation, and evaluation of laser electro-optic engineering technology programs. Contents include an occupational description and information on the following: program content, including a curriculum framework that details major concepts and intended outcomes and a list of student performance standards in 14 areas. The next section addresses key factors that must be considered when implementing this program: teacher characteristics, student admissions criteria, cooperative education, and student organization participation. A section on instructional resources lists suggested resources under each outcome shown in the curriculum framework. Facilities materials cover design recommendations and safety, maintenance, and liability. A suggested equipment list is followed by lists of tools and items of equipment, organized by each outcome, corresponding to the curriculum framework. Professional development material includes information on teacher technical updating and teacher standards and addresses of professional organizations and support services. A Career Merit Achievement Plan is attached. It displays the student performance standards required for entry into the field of laser electro-optic engineering and provides for documentation of students' level of achievement. (YLB)

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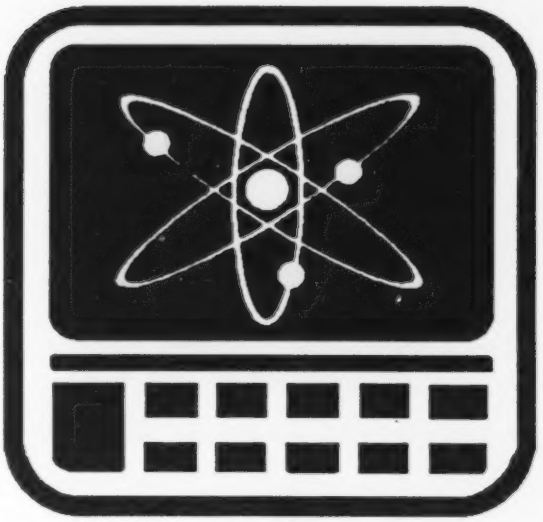

# FLORIDA VOCATIONAL PROGRAM GUIDE FOR

# LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY

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Bureau of Vocational Program and Staff Development

June, 1991

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# INTRODUCTION

Vocational education meets the needs of students desiring to pursue a selected vocation and is designed to provide training that is realistic in meeting present and future employment opportunities. In recent years, applications of science and technology have expanded rapidly, increasing the education and training required of workers. This has made vocational training programs more attractive as an educational option. The new technologies require well-trained workers to carry out both standardized and specialized procedures, and whose training foundations have given them the capacity to keep pace with continuing technology demands.

The Florida Department of Education shares with business and industry the determination to provide opportunities for upward mobility to as many Floridians as possible. Vocational training programs can keep pace with the demands of new industrial patterns and can provide the opportunity for many of our citizens to gain financial stability and an improved sense of self worth. Therefore, it is necessary to create exemplary vocational programs and to make those programs consistent throughout the state.

This Program Guide identifies primary concerns that should be considered in the organization, operation and evaluation of a vocational education program. It has been developed to provide useful information to local school district and community college administrators, instructors, program advisory committees, regional coordinating councils and others charged with the responsibility of offering vocational education programs.

# OCCUPATIONAL DESCRIPTION

One who has completed the Laser Electro-Optic Engineering Technology program may be employed to construct and test prototype laser devices, applying theory and principles of laser engineering and electronic circuits. The position may include

- Reviewing project instructions such as layout and sketches with engineering personnel
- Interpreting detail requirements such as dimensions and functional requirements

  Installing an aligning mirrors in laser body, using precision instruments
- Using vacuum pump and gas transfer equipment to purge, evacuate and fill laser body with specified volume and pressure of gases
- Assembling completed laser body in chassis, and installing tubing and wiring to connect valves, regulators, dials and and switches
- Setting up precision electronic and optical instruments to test device, using specified electrical or optical inputs
- Analyzing test data and reporting results

# PROGRAM CONTENT

The Division of Vocational, Adult, and Community Education, as required by State Board of Education (S.B.E.) **Rule 6A-6.0571**, publishes Vocational Education Program Courses Standards annually. This document specifies the minimum program content for the operation of a vocational training program for the occupational titles listed. Each program identified in the Florida Department of Education Course Code Directory is required to establish course standards. The standards for each vocational offering are comprised of two major components: (1) Curriculum Framework and (2) Student Performance Standards.

## Curriculum Framework (CF)

The Curriculum Framework specifies the exact course title, course number, levels of instruction, major course content, laboratory activities, special notes, major course concepts and intended outcomes. The program requirements stipulated in the curriculum framework have been approved by the State Board of Education and are the legal bases for delivery of instruction.

## Student Performance Standards (SPS)

The Student Performance Standards are a resource list of job-specific competencies. This list is generated and approved by industry experts and becomes the basis for curriculum development in vocational programs. Local school districts and community colleges must, by law, adopt student performance standards for their vocational programs. They may, at their discretion, adopt the list provided or develop their own as long as there is sufficient content to address each intended outcome. A program may provide instruction beyond the minimum specified in the SPS if desired. The decision to do this should be based on local industry needs. However, the minimum must be presented.

The SPS for secondary level programs contain a third component, course structure. This component specifies the number of courses required for program completion and the content of each course. The courses may be taught in any sequence, but the content may not be changed unless approved by the Division of Vocational, Adult, and Community Education.

The curriculum framework and student performance standards are intended for use as a guide, not a teaching tool. Teachers or curriculum development personnel are expected to develop or select complete curriculum materials for their training programs based on the curriculum framework and student performance standards. Each intended outcome and SPS should be thoroughly analyzed for related cognitive and procedural subskills. The curriculum framework and student performance standards are presented in the following pages.

PROGRAM CONTENT LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY

CURRICULUM FRAMEWORK PROGRAM AREA: Industrial

FLORIDA DEPARTMENT OF EDUCATION EFFECTIVE DATE: July, 1991

PROGRAM TITLE: Laser Electro-Optic Engineering Technology

CODE NUMBER: Secondary _____ Postsecondary _____

Florida CIP 0615.030401

SECONDARY SCHOOL CREDITS ____ COLLEGE CREDITS _X_ POSTSECONDARY ADULT VOCATIONAL CREDITS

APPLICABLE LEVELS(S): ___ 7-9 ___ 9-12 ___ Postsecondary Adult Vocational

_X_ Postsecondary Vocational ___ Other

CERTIFICATION COVERAGE:

I. MAJOR CONCEPTS/CONTENT: This program is designed to prepare students for employment as laser engineering technicians or in related occupations in electronics, or to provide supplemental training for persons previously or currently employed in these occupations.

Electronic Technology and/or Electronic Engineering Technology (CORE) are prerequisites for entry into this electronic specialization program. The CORE program prepares individuals to assemble, install, operate, maintain, troubleshoot and repair electronic equipment used in industry. In addition, it also includes content related to the design, theory, and analysis of electronic systems and applications.

This specialization content includes, but is not limited to, assembly, installation, operation, maintenance, troubleshooting and repairing of laser electro-optic equipment. This program contains content related to the design, theory, and analysis of laser systems and applications. The specialized content also includes optical systems and elements, laser applications, laser energy, laser optical measurements, assembly of laser components, gas lasers, and solid state lasers.

II. LABORATORY ACTIVITIES: Electronic laboratory activities are an integral part of this program. The tools, test equipment, materials and processes used in this laboratory are similar to those used in industry. Students should be able to use the various types of precision test equipment found in general use throughout the electronics industry for the purpose of analyzing, troubleshooting and repairing electronic circuitry.

III. SPECIAL NOTE: As part of an Associate in Science Degree, there is a major component of general education requirements which allows the student to more easily relate the technical knowledge gained to a theoretical level and to allow for greater knowledge expansion and transference in the future.

This general education requirement must have a minimum of 15 semester hours with at least one course in oral and written communication and one course in computational skills. The computational skills should include algebra and trigonometry.

The cooperative method of instruction may be utilized for this program. When the cooperative method is offered, the following is required for each student: a training plan signed by the student, teacher and employer which includes instructional objectives and a list of on-the-job and in-school learning experiences; and a work station which reflects equipment, skills and tasks relevant to the occupation the student has chosen as a career goal. The student must receive compensation for work performed.

To be transferable statewide between institutions, this program/course must have been reviewed, and a "transfer value" assigned the curriculum content by the appropriate Statewide Course Numbering System discipline committee. This does not preclude institutions from developing specific program or course articulation agreements with each other.

The typical length of this program for the average achieving student is an Associate Degree.

IV. INTENDED OUTCOMES: After successfully completing this program, the student will be able to:

01. Demonstrate proficiency, identification and use of lasers.
02. Demonstrate and practice the use of optical elements.
03. Demonstrate and analyze wave optical systems.
04. Perform laser technology applications.
05. Calibrate, troubleshoot, and analyze laser peripheral components.
06. Demonstrate and practice laser energy applications.
07. Analyze, construct and demonstrate laser optical measurements.
08. Demonstrate proficiency in analysis and evaluation of wave optical systems.
09. Demonstrate proficiency in analysis, assembly of laser components, and test beam characteristics.
10. Demonstrate proficiency in optical systems, making use of wave characteristics of light.
11. Demonstrate proficiency in operating output beam characteristics of various gas lasers.
12. Demonstrate proficiency in solid-state lasers in various operational modes.
13. Demonstrate proficiency in laser systems designs appropriate to assigned applications.
14. Demonstrate proficiency planning and documenting a laser-oriented project.

STUDENT PERFORMANCE STANDARDS EFFECTIVE DATE: July, 1991

PROGRAM AREA: Industrial SECONDARY NUMBER:

PROGRAM TITLE: Laser Electro-Optic Engineering Technology POSTSECONDARY NUMBER:

01.0 DEMONSTRATE PROFICIENCY, IDENTIFICATION AND USE OF LASERS--The student will be able to:

- 01.01 Identify and apply laser safety practices.
- 01.02 Define and identify the elements and operation of a laser.
- 01.03 Operate a power meter.
- 01.04 Demonstrate proper cleaning techniques for optical material.
- 01.05 Identify and utilize component supports.
- 01.06 Analyze the use of filters and beam-splitters.
- 01.07 Define and analyze the properties of light.
- 01.08 Measure and analyze the emission and absorption of light.
- 01.09 Define and analyze lasing action.
- 01.10 Identify, analyze and define optical cavities and modes of oscillation.

02.0 DEMONSTRATE AND PRACTICE THE USE OF OPTICAL ELEMENTS--The student will be able to:

- 02.01 Describe and analyze temporal characteristics.
- 02.02 Describe and analyze spatial characteristics.
- 02.03 Define and analyze the characteristics of a gas laser.
- 02.04 Define laser classifications and characteristics.
- 02.05 Define reflection and refraction.
- 02.06 Apply principles of reflection graphically and experimentally.
- 02.07 Apply principles of refraction graphically and experimentally.
- 02.08 Apply principles of imaging with a single lens graphically and experimentally.
- 02.09 Apply principles of imaging with a multiple lens graphically and experimentally.
- 02.10 Apply principles of the effect of F-stop and apertures graphically and experimentally.

03.0 DEMONSTRATE AND ANALYZE WAVE OPTICAL SYSTEMS--The student will be able to:

- 03.01 Identify and analyze light sources and their characteristics.
- 03.02 Define and describe the quantities of radiometric and photometric in the radiation of energy/power.
- 03.03 Describe and define the wave nature of light.
- 03.04 Analyze reflection and refraction using the principles of the wave nature of light.
- 03.05 Identify and apply the effects of propagation of light.
- 03.06 Demonstrate the interference light.
- 03.07 Define and apply the principles of the diffraction of light.
- 03.08 Demonstrate the polarization of light.
- 03.09 Operate polarizers.
- 03.10 Define and analyze the coupling of light into fiber optics.
- 03.11 Analyze the propagation of light in fiber optics.
- 03.12 Describe the construction of optical fibers.

03.13 Identify and describe the losses in fiber optics.
03.14 Identify the advantages and disadvantages of fiber optics.

04.0 PERFORM LASER TECHNOLOGY APPLICATIONS--The student will be able to:

04.01 Define and apply nondestructive testing techniques.
04.02 Define and apply range finding.
04.03 Define and apply alignment and angle testing.
04.04 Construct four types of interferometers.
04.05 Construct and use a holography system.

05.0 CALIBRATE, TROUBLESHOOT, AND ANALYZE LASER PERIPHERAL COMPONENTS--The student will be able to:

05.01 List the properties of different types of optical materials.
05.02 Define and demonstrate the limitations of optical materials.
05.03 Define and demonstrate windows and flats.
05.04 Define and demonstrate mirrors and etalons.
05.05 Apply and analyze prisms.
05.06 Apply and analyze the use of lenses.
05.07 Apply and analyze the use of gratings.
05.08 Apply and define nonlinear materials.
05.09 Apply beam expanders and spatial filters.

06.0 DEMONSTRATE AND PRACTICE LASER ENERGY APPLICATIONS--The student will be able to:

06.01 Apply and define laser safety, hazards and evaluation.
06.02 Troubleshoot and analyze pulsed laser flashlamps and power supplies.
06.03 Troubleshoot and use power sources for CW lasers.
06.04 Define and analyze the use of CW solid lasers-efficiency and cooling.
06.05 Measure and record laser power and energy.
06.06 Apply laser beam divergence and focusing.
06.07 Troubleshoot and define optically pumped pulsed solid lasers.
06.08 Troubleshoot and define laser Q-switching.
06.09 Apply and define semiconductor lasers.

07.0 ANALYZE, CONSTRUCT AND DEMONSTRATE LASER OPTICAL MEASUREMENTS--The student will be able to:

07.01 Operate and analyze electro-optic devices.
07.02 Operate and analyze acousto-optic devices.
07.03 Define mode-locking.

08.0 DEMONSTRATE PROFICIENCY IN ANALYSIS AND EVALUATION OF WAVE OPTICAL SYSTEMS--The student will be able to:

08.01 Measure the imaging properties of single lenses.
08.02 Measure the magnification of multiple lens systems.
08.03 Adjust the telescope for collimation.
08.04 Measure and correct lens system for minimum aberration.
08.05 Measure the effect of F-stops and apertures.

08.06 Measure the properties of gratings.
08.07 Describe the fundamental characteristics of image erection systems.
08.08 Apply the matrix method of ray tracing through optical systems.
08.09 Analyze the effective use of filters and beam splitters.
08.10 Test the stability of optical mounting methods.
08.11 Measure light intensity in photometric units.

09.0 DEMONSTRATE PROFICIENCY IN ANALYSIS, ASSEMBLY OF LASER COMPONENTS, AND TEST BEAM CHARACTERISTICS--The student will be able to:

09.01 Identify and analyze light sources and their characteristics.
09.02 Define and describe the quantities of radiometric and photometric in the radiation of energy/power.
09.03 Describe and define the wave nature of light.
09.04 Demonstrate the effects of reflection and refraction.
09.05 Demonstrate the effects of propagation of light.
09.06 Demonstrate the interference light.
09.07 Demonstrate the diffraction of light.
09.08 Distinguish between specular, diffuse and fresnel reflections.
09.09 Demonstrate the use of polarizers.
09.10 Measure filter absorption and optical density.
09.11 Observe and calculate (using several light sources) the wave length and frequency of prominent spectral lines.
09.12 Assemble and align a HeNe laser resonator.
09.13 Measure beam diameter and divergence.
09.14 Set up and operate a spectrometer.
09.15 Demonstrate proper cleaning of an uncoated optical surface.
09.16 Measure and diagram reflection characteristics of plan surfaces.
09.17 Measure transmission and absorption of optical materials (propagation).
09.18 Analyze photodectors.
09.19 Troubleshoot photodectors.
09.20 Calibrate photodectors.

10.0 DEMONSTRATE PROFICIENCY IN OPTICAL SYSTEMS, MAKING USE OF WAVE CHARACTERISTICS OF LIGHT--The student will be able to:

10.01 Measure and diagram reflection characteristics of spherical surfaces.
10.02 Measure and diagram refraction characteristics of plan surfaces.
10.03 Measure and diagram refraction characteristics of spherical surfaces.
10.04 Demonstrate diffraction and interference.
10.05 Demonstrate polarization characteristics of light.
10.06 Demonstrate the optical characteristics of prisms.
10.07 Demonstrate the optical characteristics of windows.
10.08 Demonstrate the fundamental characteristics of wedges.
10.09 Measure the local length of spherical single lenses.
10.10 Demonstrate the optical path differences in thin films.
10.11 Design and construct a laser-up collimator.
10.12 Measure the wave length of basic lasers.
10.13 Measure the temporal output of basic lasers.
10.14 Measure the spatial output of basic lasers.

10.15 Make a qualitative interpretation and assessment of the surface quality of a test optical surface, based on the interference patterns produced from the surfaces of an optical flat, wedged and curved spherical.
10.16 Set up and operate a monochromator.
10.17 Set up and operate a Michelson interferometer.
10.18 Set up and operate a Fabry-Perot interferometer.
10.19 Set up and operate a Twyman-Green interferometer.
10.20 Measure the longitudinal mode spacing of a TEMOoo laser, utilizing optical spectrum analyzer.

11.0 DEMONSTRATE PROFICIENCY IN OPERATING OUTPUT BEAM CHARACTERISTICS OF VARIOUS GAS LASERS--The student will be able to:

11.01 Analyze power sources for CW lasers (gas and solid state).
11.02 Troubleshoot power sources for CW lasers (gas and solid state).
11.03 Analyze pulsed laser power supplies.
11.04 Troubleshoot pulsed laser power supplies.
11.05 Analyze energy transfer in laser systems (automatic, ionic and molecular).
11.06 Calculate energy transfer in laser systems (atomic, ionic and molecular).
11.07 Analyze CW lasers.
11.08 Troubleshoot CW lasers.
11.09 Analyze pulsed lasers.
11.10 Troubleshoot pulsed lasers.
11.11 Demonstrate the effects of Q-switching.
11.12 Demonstrate the use of autocollimators.
11.13 Demonstrate Q-switching methods (dye, EO, AO and mechanical).
11.14 Demonstrate use of modulators and deflators.
11.15 Calculate/measure percentage of transmission of CW CO2 laser beam through uncoated GE lens.
11.16 Combine helium, nitrogen and carbon dioxide in CO2 laser and determine power output for various mixture ratios.

12.0 DEMONSTRATE PROFICIENCY IN SOLID-STATE LASERS IN VARIOUS OPERATIONAL MODES--The student will be able to:

12.01 Analyze and troubleshoot flashlamp ignition and simmer circuits.
12.02 Determine beam convergence as function of lamp current to produce graph of lamp current vs. Nd:YAG laser.
12.03 Demonstrate Q-switching methods.
12.04 Demonstrate frequency doubling in Nd:YAG laser.
12.05 Measure output beam characteristics of a pulsed Nd:YAG laser.
12.06 Design and construct a breadboard pulse-forming network containing a gas-filled flashlamp.

13.0 DEMONSTRATE PROFICIENCY IN LASER SYSTEMS DESIGNS APPROPRIATE TO ASSIGNED APPLICATIONS--The student will be able to:

13.01 Choose the best laser to use for a given material processing application.

13.02 List the variables that determine the speed and quality of material procession applications.
13.03 Measure and adjust the output characteristics of laser beams.
13.04 Describe the alignment procedure of an articulated arm beam delivery system.
13.05 Draw a schematic illustration of the optical system of a micromanipulator used to position a CO2 laser beam on a medical target.
13.06 Demonstrate the effect on a tissue target of varying the focal length of an objective lens.
13.07 Determine atmospheric attenuation factors, and the amount of laser power-energy needed to transmit a laser beam over a given range through specified atmospheric conditions.
13.08 List 5 major differences and the same number of similarities of Nd:YAG lasers used for each of the three major applications.
13.09 List 5 major differences and the same number of similarities of CO2 lasers used for each of the three major applications.
13.10 Describe the difference between target designators and rangefinders.

14.0 DEMONSTRATE PROFICIENCY PLANNING AND DOCUMENTING A LASER-ORIENTED PROJECT--The student will be able to:

14.01 Demonstrate medical laser safety.
14.02 Demonstrate ANSI laser safety standards.
14.03 Demonstrate CDRH laser safety standards.
14.04 Perform safety assessment of a facility which uses laser devices.

# PROGRAM IMPLEMENTATION

It is the teacher's responsibility to ensure that students learn how to competently perform the tasks specified in the course objectives. Therefore, the teacher must lead the students through the learning experiences in a course, motivate students, act as a role model for students, and at times, function as a guidance counselor and placement coordinator. This leadership role requires the teacher to participate in many of the activities required for program implementation. The teacher must select the methods of instruction that best apply to students' ability levels, measure student achievement and provide feedback. Key factors that must be considered when implementing this program are addressed below.

## TEACHER CHARACTERISTICS

### Subject Knowledge

The teacher must be a subject matter expert who is able to implement sound instructional methods and evaluate student performance. He/she must have significant work experience in the industry/vocational field and be able to communicate that knowledge to the students.

### Instructional Delivery

The teacher's role in the learning process is to motivate and lead the student as well as impart subject matter knowledge. In order to maximize student learning, the use of a variety of instructional methods is encouraged. Because teaching styles vary greatly, teachers are highly encouraged to "pick and choose" from various methods or to combine methods for maximum benefit to students. Some of the more traditional methods used are lecture, demonstration and small group instruction. Other teaching methods which are suggested for further exploration include individualized self-paced, open-exit/open-entry, contract, computer based and competency based instruction. The focus of Competency Based Vocational Education (CBVE) is to ensure that each student can competently perform tasks specified before progressing to more complex skills.

### CONVENTIONAL INSTRUCTIONAL METHODS

A vocational program may require a portion of the instruction to be presented in a standard lecture or controlled demonstration format. These methods of instruction can be easily combined with instructor controlled step-by-step practical exercises. Some instructional activities may dictate that this instructional approach be used to introduce students to hazardous equipment often utilized in vocational training. In most situations, students should be required to perform specified activities to achieve maximum skill competency. If mastery of a task is required, competency based education methods may be more appropriate. However, if the training activity involves an orientation or a seldom performed, non-essential task, conventional instructional methods may be more effective. Teachers are encouraged to use a variety of instructional methods to best meet instructional objectives.

#### Instructional Development

Teachers often must develop and select their own teaching and curriculum materials. In developing a comprehensive curriculum, instructional objectives based upon both the performance and cognitive domain must be included. When developing curriculum materials, teachers must use the curriculum framework (CF) and student performance standards (SPS) contained in this program guide as a basis. These materials delineate minimim program content which must be presented for an approved vocational training program. However, they are not intended for use as a comprehensive curriculum. Be certain not to adapt the curriculum to available materials, but select only those materials which can be adapted to the curriculum.

#### Instructional Measurement

Teachers must select testing methods that support the instructional delivery system used. Teachers must be competent to develop, administer and evaluate written and performance type tests.

## Student Admissions Criteria

Providing the student the opportunity to successfully complete a vocational education program, in any institution, should be the primary concern of the instructional effort. Therefore, it is very important to direct planning and effort into identifying and selecting students with excellent potential for success in the educational program and in the occupation. The school's primary task is to prepare people for fulltime, entry-level positions as technicians or, in the case of those with more experience, as managers.

The Course Code Directory, specifies grade levels at which occupational programs are offered. Specific student admissions criteria which are required by the State and local educational agencies for the Laser Electro-Optic Engineering Technology training program are illustrated as follows.

## SPECIFIC ADMISSIONS CRITERIA

| | |
|---|---|
| Minimum Age: | As required by state and local policy |
| Physical Requirements: | None |
| Special Requirements: | None |
| Minimum Basic Skills Math Level: | * 10.0 |
| Minimum Basic Skills Language Level: | * 9.0 |

* This grade level requirement is specified in the Curriculum Framework and is applicable to postsecondary level programs of 450 hours or more only. There is no minimum basic skill requirement for secondary programs.

## THE STUDENT PROFILE

Developing a student profile is an important step in program implementation. Attention should focus on student characteristics that can be remediated within a training program, but could create serious impediments to success in the vocational field. Typical of these would be deficiencies in communication and mathematical skills. The basic skill levels can be measured by testing. Test results can then be used to direct the student to more suitable training which matches his or her skill level, or to determine supplemental training which may be required to increase chances for student success.

High school and postsecondary vocational students can be admitted to a vocational program upon request if they meet any specified prerequisites, such as physical or basic skill requirements. Training programs should be accessible to as many students as possible. Training programs are designed to prepare students for employment upon graduation, or serve as prerequisite to a postsecondary program.

The community college can be more selective and establish stringent admission standards. This may be done by assessing applicants or by recruiting potential students who meet the established prerequisite requirements of the training. The program advisory committee can design a profile of the potentially successful student. The profile should contain a

list of qualities, traits and aptitudes that will indicate a higher potential for student success. Acceptable levels for these traits must also be determined. For example, the qualities deserving highest attention, mechanical ability and cognitive aptitude, are those which the educational program itself will not likely be able to influence, although these traits should have considerable weight in establishing the basic profile. Deficiencies in mathematical or communication skills may lend themselves to improvement through related instruction while the student is enrolled in the program. The following example illustrates specific qualities to consider when establishing the student profile:

**Mechanic/Technician--Service**

- Knowledge of basic tools and equipment used by mechanics/technicians
- Ability to analyze and solve mechanical and technical problems
- Ability to interpret written mechanical/technical materials
- Ability to interpret mechanical/technical drawings
- Mechanical dexterity

**Mechanic/Technical Service Management**

- Basic application of service
- Business skills
- Ability to work with people
- Communication skills
- Leadership

## QUALIFYING AND PRETESTING

Assessing potential students for vocational programs is an integral part of the recruiting process since considerable amounts of time and money will be spent on students entering training. Recruiters must have a good idea of the candidate's basic aptitude. Whoever guides the candidate to the program needs to have knowledge of the student's interests, abilities and experience. These can be measured by a variety of assessment methods, which should be performed upon program entry. The assessment can help determine extent and level of training each individual should receive.

The minimim basic skills requirement for mathematics and language skills is specified on the curriculum framework. Assessment should determine the level at which the student can read, write, calculate mathematics and understand the English language. It is appropriate for the program advisory committee and the school to develop some selection criteria based on minimum skill levels. These criteria should remain flexible in order to maximize educational opportunity for all applicants. Additionally, vocational educators must make every effort to serve the variety of "special needs" students and to eliminate sex-bias and stereotyping in all occupational areas.

## ADVISORY COMMITTEE

It is imperative that representatives of industry be organized into an advisory committee. Constantly changing technological demands of our society will continue to stimulate changing industrial patterns. Therefore, effective use of program advisory committees is vital to the successful implementation of vocational training programs. Advisory committees provide expert technical advice which is not easily obtainable elsewhere, offer external support of policies and have tremendous public relations potential.

The most effective advisory committees are those whose members have mutual respect for each other's abilities and vested interest in the training program because of their need for trained workers. The program advisory committee is also one of the most effective means of facilitating placement. Its role can be:

- To contact local industry and encourage them to use the school's placement office as a means of filling jobs
- To develop an effective procedure for interviewing and evaluating potential employees suggested by the school
- To assist in gathering accurate and current job information as it becomes available

## COUNSELING AND GUIDANCE

Counseling of students serves two purposes. It guides the student into the program and it supports enrolled students on a continuing basis throughout the program. Much day-to-day counseling will be the responsibility of the teacher. The teacher has the most contact with the student and is in a position to detect and correct a problem. Each student will encounter new problems as the program develops. The teacher's job is to work with the student to help identify problems and then strive for solutions. The teacher will provide much of the counseling that focuses on trade knowledge and skills.

The professional counselor cannot be expected to have the subject matter expertise of the primary teacher. The counselor, however, can focus on the student's needs related to other issues such as personal growth, interests and attitudes. The ideal situation will provide at least one counselor with current knowledge of industry standards for career counseling. A useful tool which should be used in the counseling process is the Career Merit Achievement Plan (Career MAP) which presents minimum instructional content keyed to student performance standards. Career MAPs are available for each industrial program area, and can be used to document student achievement, isolate student interests, talents and weaknesses. They are also useful for placement purposes. Information on Career MAPs may be obtained by contacting the Department of Education, Division of Vocational, Adult, and Community Education, (904) 488-0484.

### STUDENT PLACEMENT

Implementing an effective placement system is integral to developing a successful vocational training program. **S.B.E. Rule 229.551 (3)(g)** requires 70 percent placement of students who have completed a vocational training program. Although placement is not always a problem, as with students already working in a related occupation, the placement program should place emphasis upon students who are seeking entry-level employment since these students have little or no experience with industry.

The task of the placement program is to locate job openings in the community. The placement coordinator or teacher must know each student's personal aims and interests in addition to the information stated on the achievement record. In many cases, teachers are the best source to match students to job openings because of their contacts with the industry advisory committee. Input concerning employment openings must come from individual business establishments in the community. The placement coordinator should introduce a student to as many suitable job openings as possible. Conversely, employers can then be expected to interview as many qualified candidates as possible.

## Cooperative Education

### COOPERATIVE EDUCATION APPLICABILITY

Normally, a student will complete the entire program as a full-time student before obtaining employment as a laser electro-optic technician. However, there may be situations where a student could be allowed to complete part of the program while employed as a laser electro-optic technician. At this time it is appropriate for the student to enroll in industrial cooperative education (ICE). Guidelines for this training plan are provided in the "Industrial Cooperative Education Program Guide," published by the Division of Vocational, Adult, and Community Education, Order # IE 508 BK 87.

Industrial cooperative education is a method of instruction designed to prepare students for jobs in the community. This method is a joint effort between the school and the business community. Student trainees receive a combination of instruction in the classroom and related on-the-job training through employment. Learning experiences are jointly planned and supervised by the teacher and the employer. Cooperative education is relevant to the needs of the student preparing for a work role, and will help the student to achieve success and personal satisfaction as the transition is made from school to the constantly changing world of work.

Cooperative education is defined in the Federal Register, Volume 39, number 143, Vocational Education, Section 102.96, as a program ". . . to prepare students for employment, through: (a) providing meaningful work experiences combined with formal education enabling students to acquire knowledge, skills, and appropriate attitudes, (b) removing the artificial barriers which separate work and education, (c) involving educators with employers, creating interaction whereby the needs and problems of both are made known, thereby making it possible for occupational curricula to be revised to reflect current needs in various occupations . . . ."

## PURPOSE

Cooperative Education is for persons who, through written cooperative arrangements between the school and employers, receive instruction, including required academic courses and related instruction by alternation of study in school with a job in any industrial occupational field. These two experiences must be planned and supervised by the school and employers so that each contributes to the student's education and employability. Work periods and school attendance may be on alternative half days, full days, weeks or other periods of time to fulfill objectives of the cooperative education program.

## GOALS AND OBJECTIVES

The primary goal of the cooperative method of vocational education is to prepare skilled, responsible individuals who can assume a productive role in the community. Specific objectives to meet the primary goal are:

- To prepare individuals for employment, adjustment and advancement in specified occupations or occupational areas (primary objective)
- To provide an understanding of the contribution of work to the social and economic welfare of our nation
- To provide students with an understanding and appreciation of the American free enterprise system
- To foster an awareness of the civic, social and moral responsibilities of individuals to society

- To stimulate students' interest in their chosen occupational fields and provide an understanding of the opportunities in each field
- To provide training that results in increased efficiency in performing job tasks
- To provide curriculum which is sensitive and adaptable to changes in occupational practices and procedures as they are affected by societal, economic, technical and educational developments
- To strive to develop a greater appreciation of the value of specifically trained personnel among employers, employees and consumers
- To reinforce skills learned in the school laboratory
- To provide experiences on tools and equipment not available in the school laboratory
- To supplement and broaden the school curriculum into areas not otherwise available

## Student Organization Participation

Vocational student organizations operate pursuant to federal and state laws, which authorize them as viable components of vocational education programs. According to federal regulations, the vocational education program of instruction may include activities of vocational student organizations which are an integral part of the vocational instruction offered and which are supervised by vocational education personnel. The **S.B.E.** Rules authorize vocational student organizations as an integral part of the vocational education program as stated in **S.B.E. 6A-6.064 (7)** and **6A-6.065 (8).**

### VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)

VICA is an organization for secondary or postsecondary students enrolled in trade and industrial education programs in high schools, area vocational technical centers and junior and community colleges. It is the only national and international organization for trade and industrial students. The organization is designed to expand and enrich opportunities for leadership, social awareness and civic responsibility in vocational students.

Students who participate in VICA activities are often better prepared for the world of work. They acquire knowledge of the many opportunities available in their chosen careers and become aware of the value of their

contributions to society. They are also given opportunities to develop and utilize their talents and abilities in ways that otherwise would not be available to them.

## BENEFITS OF VICA MEMBERSHIP FOR THE STUDENT

Membership in VICA offers the student the opportunity for growth and development in the following areas:

**School and Community Service Activities** Students in VICA become involved in various school and/or community services. These may include clothing or food collections for the needy, donation of time and service to the elderly and participation in fund raisers or similar activities.

**Social Interaction with Fellow Students** Activities are also available that offer students time for relaxation and fun. Social activities of this type may be held on a regular basis. They might be held on the school campus during school hours, or off campus after school. More formal functions would include end of the year award banquets or industry/employer appreciation dinner banquets.

**Competition in Skill and Leadership Contests** VICA offers various contests in all the skill and leadership areas it serves. Often, teachers identify talented students who represent their school in regional competitions. However, any student member of VICA may compete. Instructors should conduct planned contests within their trade areas. This also pertains to leadership areas. First and second place regional winners then move on to the state level contest. The state winners then compete at the national level of the United States Skill Olympics.

# INSTRUCTIONAL RESOURCES

## STUDENT REFERENCE MATERIALS

Necessary instructional texts or pertinent material should be available for each student to satisfy training objectives. When textbooks are used, the copyright date should be as current as possible.

## SERVICE MANUALS

Manuals with current manufacturer's service procedures and specifications should be available. These manuals must be located where students can use them while working in the shop area.

## PERIODICALS

Current general and technical magazines and newspapers should be available for student and instructor use.

The following list of suggested resources is organized under each outcome shown in the curriculum framework. These resources have been recommended by instructors and program administrators.

## 01.0 DEMONSTRATE PROFICIENCY, IDENTIFICATION AND USE OF LASERS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Introduction to Lasers* | CENTER FOR OCCUPATIONAL RESEARCH AND DEVELOPMENT (CORD) | text |

## 02.0 DEMONSTRATE AND PRACTICE THE USE OF OPTICAL ELEMENTS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

## 03.0 DEMONSTRATE AND ANALYZE WAVE OPTICAL SYSTEMS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Fundamentals of Optics* Jenkins & White | McGRAW-HILL BOOK COMPANY | text |
| *Geometrical Optics* | CORD | text |
| *Light Sources and Wave Optics* | CORD | text |

## 04.0 PERFORM LASER TECHNOLOGY APPLICATIONS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Laser Technology* | CORD | text |

## 05.0 CALIBRATE, TROUBLESHOOT, AND ANALYZE LASER PERIPHERAL COMPONENTS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

## 06.0 DEMONSTRATE AND PRACTICE LASER ENERGY APPLICATIONS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Solid State Laser Engineering*<br>Walter Koechuer | | text |

## 07.0 ANALYZE, CONSTRUCT AND DEMONSTRATE LASER OPTICAL MEASUREMENTS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Laser and Electro-Optics Components* | CORD | text |

## 08.0 DEMONSTRATE PROFICIENCY IN ANALYSIS AND EVALUATION OF WAVE OPTICAL SYSTEMS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

09.0 DEMONSTRATE PROFICIENCY IN ANALYSIS, ASSEMBLY OF LASER COMPONENTS, AND TEST BEAM CHARACTERISTICS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

10.0 DEMONSTRATE PROFICIENCY IN OPTICAL SYSTEMS, MAKING USE OF WAVE CHARACTERISTICS OF LIGHT

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

11.0 DEMONSTRATE PROFICIENCY IN OPERATING OUTPUT BEAM CHARACTERISTICS OF VARIOUS GAS LASERS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

12.0 DEMONSTRATE PROFICIENCY IN SOLID-STATE LASERS IN VARIOUS OPERATIONAL MODES

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| NONE | | |

13.0 DEMONSTRATE PROFICIENCY IN LASER SYSTEMS DESIGNS APPROPRIATE TO ASSIGNED APPLICATIONS

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|
| *Laser Applications* | CORD | text |

## 14.0 DEMONSTRATE PROFICIENCY PLANNING AND DOCUMENTING A LASER-ORIENTED PROJECT

| TITLE, AUTHOR, ORDER# | PUBLISHER | TYPE |
|---|---|---|

NONE

**PUBLISHERS' ADDRESSES**

CENTER FOR OCCUPATIONAL RESEARCH &
DEVELOPMENT (CORD)
601C Lake Air Drive
Waco, TX 76710

McGRAW-HILL BOOK COMPANY
1221 Avenue of the Americas
New York, NY 10020

# FACILITIES

## Facility Design Recommendations

Facilities, tools and equipment are essential parts of training programs, and must be designed to meet State program standard requirements and instructional objectives. This section of the Program Guide contains information for setting up classroom and laboratory facilities. Facility design criteria and space requirements are specified in **S.B.E. Section B, Chapter 6A-2.**

### TEACHING FACILITIES

The instructional environment should duplicate, as closely as possible, the real-life work environment the student will enter after graduation. The more the school resembles the industrial environment, the easier it will be for the student to make the transition from school to work. Tools, supplies and equipment should conform to local industry standards. The teacher should actively pursue supplemental resources to expose the students to state-of-the-art equipment.

All facilities should include classroom space, as well as space for regular classroom equipment such as audio-visual equipment. Laboratory facilities should be equipped with work stations or workbenches, tables, chairs and special training aids to demonstrate basic principles and theory. They should contain enough tools and equipment to enable several students to work individually on the same learning activity.

### UPDATING FACILITIES

To keep pace with technological changes and improvements, facilities must be updated on a continuing basis. When planning facilities, priority must be to provide space which will fulfill changing needs of the instructional program. Buildings should be designed with flexibility to expand in order to accommodate future program changes and to allow for greater ease of facility updating. The program advisory committee should be used to assist the school in establishing priorities for obtaining facilities, tools and equipment. Careful planning and analysis of current and future needs will lead to the establishment of an effective training environment.

## SCHOOL FACILITIES

### Laser Electro-Optic Engineering Technology

This section of the program guide provides guidelines for Laser Electro-Optic Engineering Technology program facilities. All vocational programs must meet additional facility requirements specified in **S.B.E. Section B, Chapter 6 A-2.**

The classroom/laboratory areas should be designed to accommodate oversized machinery, equipment, materials and holding tables. Each area should be equipped with special lighting, as necessary. The area should provide oversized openings equipped with service entry doors to the movement and transporting of oversized equipment, materials and products.

The laboratory should include electrical outlets providing 110 volts at each work station. Electrical outlets should be permanently mounted to the work station benches. Additional electrical outlets should be installed along the walls and in the center areas of the laboratory. Electrical outlets in the center areas should be mounted on posts between the ceiling and work stations or on pull down extension systems. Special electrical wiring may be required to supply the power requirements of specialized equipment. All electrical service must be installed according to local building code requirements.

## CLASSROOM/LABORATORY FACILITIES

Space requirements for **new** facility construction for this program are specified in **S.B.E. Rule 6A-2.032** as shown below.

**NEW FACILITIES**
LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY

| | |
|---|---|
| Occupant Design Stations | 20 |
| Net Square Feet Per Occupant | |
| Minimum | 70 |
| Normal | 80 |
| Maximum | 90 |
| Total Net Square Feet | |
| Minimum | 1400 |
| Normal | 1600 |
| Maximum | 1800 |

## WORK STATION ARRANGEMENT

The arrangement of work stations and specialized equipment depends upon the general layout of the facilities, but careful consideration must be given to convenience to entrances and exits, easy movement among work stations and tool/storage areas. The area should have a counter convenient to work stations. Overall layout of the facility should be planned so that the location of entrances and exits permits a logical flow of work in progress. One of the most critical factors in planning a facility is the arrangement of work stations to obtain a safe, efficient traffic pattern.

## ADDITIONAL FACILITY CONSIDERATIONS

### Training Stations

Training stations and live work areas must be available in the type and number required to meet program goals and performance objectives.

### Instructional Area

A classroom or designated area of the laboratory should be available for lecture, instruction, viewing audio visual materials and other nonshop activities.

### Personal Tool/Equipment Storage Area

A secure storage room or area should be provided, with enough shelf space for student supplies/tool boxes and floor space for equipment.

### General Storage

Storage areas for tools, parts, supplies and machines must be sufficient to support the activities outlined in the program goals and performance objectives.

### Office Space

An area separate from the classroom and laboratory should be available and convenient for use by the instructor(s) as an office.

### Maintenance

A regular facilities maintenance program must be implemented to ensure that equipment and facilities are safe and usable to meet instructional needs.

### Housekeeping

The classroom, laboratory and support area(s) must be kept clean and orderly.

**Ventilation**

A fume/dust removal system should be in place and operable. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning. Ventilation requirements are stated in **S.B.E. Rule 6A-2.066.**

**First Aid**

A first aid station must be in place, well marked and complete with appropriate supplies.

**Support Facilities**

Restrooms, clean-up areas and lockers convenient to the shop should be available for students.

**Safety**

The facilities must meet all Occupational Safety and Health Administration (OSHA) safety standards, where applicable.

**Facility Evaluation**

The program advisory committee should be asked to conduct an annual evaluation of the facilities to insure the program's continuing capability to meet instructional objectives.

# Safety, Maintenance and Liability

**SAFETY**

**S.B.E. Rule 6A-2.097**

The Florida State Board of Education establishes rules for the operation of public schools. **Part III, Section B, Chapter 6A-2** of the State Board of Education Rules contains the standards for existing educational facilities. Subsections deal with the entire school facility in regard to such topics as electrical equipment, flammable materials, ventilation, fire safety, storage and illumination. Subsection 6A-2.097 contains safety regulations pertaining to vocational classes.

The statute requires 100 percent protection of every student and teacher participating in laboratory work wherein the type of activities listed in the statute above are conducted. This will include: demonstration by teachers or students, students and teachers present in a room or laboratory when students are engaged in make-up work or project work, and when anyone is using tools for construction or repair work involving the shaping or cutting of any solid materials.

Rules and regulations for an eye protection program should be organized and distributed to teachers, students and school personnel. Safety devices should be worn by those participating in the activity and by those who are observers or who may be in close proximity.

**Marking of Hazardous Areas**

Floors, walls, posts, stationary objects, machinery and equipment should be properly painted, marked, coded or identified, according to recommended safety practices of OSHA, the school board and industry.

**Emergency Procedure For Injuries**

The following procedures are recommended in the event of an injury or sudden illness in a student:

- Refer to the red "fire or medical emergency" signs posted in appropriate areas.
- Provide immediate first aid if so qualified.
- Notify appropriate personnel to advise them of the problem. They can also contact emergency trained personnel on campus.
- A conscious person has the right to refuse treatment and/or transportation to a medical facility.
- Advise students that they will be financially responsible for ambulance and emergency care.
- The paramedics will assume patient care upon arrival.
- If emergency transportation is not indicated, the student may spend time at the clinic, be allowed to go home or go to a medical facility.
- Be sure to complete the appropriate student injury form for any and all accidents or sudden illness.

## MAINTENANCE

Schools should have the necessary facilities for routine maintenance. Special maintenance requirements for this program concern the hand and power tools and machines. Arrangements must be made to accomplish routine and non-routine maintenance of hand and power tools and cutting and shaping machines. Arrangements can be made through the school's shop or an outside agency.

## VOCATIONAL TEACHER LIABILITY

### Liability of Teacher and School Board

Negligence of vocational education teachers can cause unnecessary injury, and may result in teacher and school district liability. Vocational teachers are recommended to carry personal liability insurance. To reduce the risk of liability and injuries, the following suggestions are provided.

- Follow accepted policies of the school board.
- Do not allow students to use equipment or tools which have not been approved by the administration and Board of Education.
- Establish safety rules and enforce them.
- Do not leave the shop/laboratory while students are working.
- Do not permit non-enrolled students to use the shop/laboratory.
- Do not allow students to use machines or tools for which instruction has not been given.
- Do not approve unsupervised student activities inside or outside the shop/laboratory.
- Prepare accident forms for all accidents.
- Regularly inspect the workplace and equipment for defects or potential hazards and maintain documentation of unserviceable or hazardous items.
- Consider age, maturity, skill and ability of students when providing instruction and supervision.
- Administer safety tests to students upon completion of the demonstration of a specific machine, tool or process and keep documentation on file in your office.
- Require all students to wear eye protection devices, when appropriate, for laboratory activities.

# SUGGESTED EQUIPMENT LIST

## General Classroom Equipment

**DESCRIPTION**

Chalkboard

Bulletin board

Bookcases

Cabinet-storage

Student study stations

Audio-visual equipment as needed

## Laboratory Tools and Equipment

These tools and items of equipment are normally used in this program. Equipment items are listed under each outcome, corresponding to the curriculum framework. Consumable supplies should be readily available to assure continuous instruction. Consumable supplies such as solder and wire are not contained in the equipment list.

### 01.0 DEMONSTRATE PROFICIENCY, IDENTIFICATION AND USE OF LASERS

**DESCRIPTION**

Auto-collimater
Filter material, neutral density, OD=2
Filter materials, various colors and thickness
Hene laser, .5 mw
Hene laser, removable mirrors
Lab jack, scissor 6"x 6"
Lab jack, small scissor 3"x 3"

Laser power meter with detector head
Laser rod, Nd Yaq
Laser rod, Nd glass
Light source, mercury
Meter optical rail, for X-Y translators
Micrometer, microns
Microscope slides
Optical cleaning kit
Optical power meter, spectra
Optical rails, .5 and 1.0 meter
Optics system, Pasco Scientific advanced optics system
Plastic filters, blue, green, and red
Power supply, for hene tube
Rod and Rod holders
Safety goggles, hene laser
Safety goggles, ultra violet
Spectral tube, helium and neon
Spectroscope, direct viewing grating
Strip chart recorder
Support, attach to optical rail to hold hene tube
Tools, laser disassembly
Translators, X-Y
Universal carriers

## 02.0 DEMONSTRATE AND PRACTICE THE USE OF OPTICAL ELEMENTS

### DESCRIPTION

Bean riser, vertical
Concave mirror, front surface
Convex mirror, front surface
D.C. motor, small
Lenses, various focal lengths
Meter, 0-10 MA
Microscope, traveling stage
Optics set, (Edmund Scientific, Ray Box)
Oscilloscope
Pinhole, adjustable
Pinholes, various sizes
Plane mirror, front surfact
Source, variable 110v
VOM, to measure 5000 volts D.C.
Water tank, rectangular

## 03.0 DEMONSTRATE AND ANALYZE WAVE OPTICAL SYSTEMS

### DESCRIPTION

ARC lamps, zinc, xenon, krypton,
Broad band filters
Calcite crystal
Fluorescent light, 7 to 15 watts
Interferometer (Michelson)
Mica, sheet
Microscope slides
Nicol prisms
Polarizer, full circle
Polarizing material
Spectral lamps: Hq, Cd, 2n, He, Ne, A, K+, Xe
Spectroscope

## 04.0 PERFORM LASER TECHNOLOGY APPLICATIONS

### DESCRIPTION

Film processing equipment
Glass plates, 2x3 inches for holding holography film
Interferometer (Pasco Scientific)
Isolation table, vibration
Lens, coated and uncoated anti-reflection
Mirror mounts, adjustable
Optical flat, 1/10 wave
Polarizor rotator, standard
Precision rotators

## 05.0 CALIBRATE, TROUBLESHOOT AND ANALYZE LASER PERIPHERAL COMPONENTS

### DESCRIPTION

Accelerometer
Glass, frosted
Gratings
Interferometer (Tyman-Green)
Optical flats
Precision flat reflector
Prisms: Amici, dove, right-angle, wedge
Reflection grating
Retardation plate, 1/4 ', 1/2 '
Retroreflector

## 06.0 DEMONSTRATE AND PRACTICE LASER ENERGY APPLICATIONS

### DESCRIPTION

Argon laser, single and multi line optics
CO2 laser, with complete flowing gas system
Calorimeter
Glass laser with removable mirrors, pulsed Nd Yag or Nd
Glass laser with removable mirrors, CW, Nd, Yag
HR & OC Mirrors, various radii
Hene laser tube, 5. mw
Laser, gallium arsenide with pulser and power supply
Lenses, CO2
Mirror mounts, precision
Optical power meter, 10.6 micron wavelength
Photodiode, pulse duration measurement
Safety goggles, CO2
Safety goggles, Nd Yag
Switch and power supply, Nd Yag
Tesla coil

## 07.0 ANALYZE CONSTRUCT AND DEMONSTRATE LASER OPTICAL MEASUREMENTS

**DESCRIPTION**

Acousto-optic device
Acousto-optic signal generator
Electro-optic modulator
Electro-optic modulator power supply
Oscilloscope camera
Waveplate, 1/2" for hene laser

## 08.0 DEMONSTRATE PROFICIENCY IN ANALYSIS AND EVALUATION OF WAVE OPTICAL SYSTEMS

**DESCRIPTION**

Beam splitter

## 09.0 DEMONSTRATE PROFICIENCY IN ANALYSIS, ASSEMBLY OF LASER COMPONENTS, AND TEST BEAM CHARACTERISTICS

**DESCRIPTION**

Monospec, 27
Optical chopper
Polarometer, polarizer
Pyroelectric radiometer
Vapor lamp, sodium

## 10.0 DEMONSTRATE PROFICIENCY IN OPTICAL SYSTEMS, MAKING USE OF WAVE CHARACTERISTICS OF LIGHT

**DESCRIPTION**

Flouride window, calcium
Interferometer (Fabry-Perot)
Optical spectrum analyzer

## 11.0 DEMONSTRATE PROFICIENCY IN OPERATING OUTPUT BEAM CHARACTERISTICS OF VARIOUS GAS LASERS

**DESCRIPTION**

Laser, CO2
Lens, coated GE
Lens, uncoated GE
Lens, znse
Power supply, high voltage

## 12.0 DEMONSTRATE PROFICIENCY IN SOLID-STATE LASERS IN VARIOUS OPERATIONAL MODES

**DESCRIPTION**

NONE

## 13.0 DEMONSTRATE PROFICIENCY IN LASER SYSTEMS DESIGNS APPROPRIATE TO ASSIGNED APPLICATIONS

**DESCRIPTION**

NONE

## 14.0 DEMONSTRATE PROFICIENCY IN PLANNING AND DOCUMENTING A LASER-ORIENTED PROJECT

DESCRIPTION

NONE

# PROFESSIONAL DEVELOPMENT

## Teacher Technical Updating

Technical updating workshops are scheduled periodically throughout the State, usually in the summer months. Teachers should take advantage of the opportunity to attend the Laser Electro-Optic Engineering Technology program technical update workshops when they are held. All instructional staff are encouraged to participate in as many training opportunities as possible.

Teachers should seek opportunities with local companies to maintain currency with industry trends. During periods when school is not in session, teachers are encouraged to make arrangements to return to industry for suitable involvement in their area of expertise.

Membership in professional associations offers vocational educators an enormous range of opportunities for working together to strengthen the field and to develop personal competence and satisfaction in work. The associations have similar goals and activities. They seek excellence in program content by means of joint efforts among members, communications that keep members current, forums for the discussion of issues in the field, useful and stimulating publications and sound professional growth experiences at local, state, regional and national meetings and annual conventions. They are concerned with increasing public understanding and support of the field. Teachers are encouraged to maintain affiliation with professional organizations. A list of professional organizations follows this section of the guide.

## Teacher Standards

As a prerequisite to certification, teachers must have the required years of experience in the appropriate technical field as defined in the certification standards. For the Laser Electro-Optic Engineering Technology program, the requirements are six years continuous experience in laser electro-optics. The teacher is then judged qualified to teach upon meeting one of the following criteria: (1) regular or temporary Florida teacher's certificate with appropriate coverage, (2) Approval of local school board consistent with adopted school policy or (3) regular or temporary Florida teacher's certificate with other than appropriate coverage (has met all occupational experience requirements prescribed as a prerequisite to appropriate certification and has been approved by the school board to teach

out-of-field). Refer to the Curriculum Framework for this program to determine the appropriate occupational specialization coverage required for certification.

Instructional staff must have technical competency and meet all State and local requirements for certification. Instructors should hold current, nationally recognized certification in the subject areas taught, if awarded. Beginning teachers must be enrolled in the State Beginning Teacher Program.

A systematic method of obtaining "substitute" instructors, approved by the school board, should be used to assure instructional continuity. An orientation session for substitutes should be held on a regular basis. The substitute should be a competent instructor in the occupational area and specific competencies taught.

## Professional Organizations and Support Services

### EDUCATION ORGANIZATIONS

AMERICAN VOCATIONAL ASSOCIATION (AVA)
1410 King Street
Alexandria, VA 22314
800-826-9972

FLORIDA ASSOCIATION FOR TRADE AND INDUSTRIAL EDUCATION, INC. (FATIE)
Florida Department of Education
Industrial Education - Vocational Division
Knott Building
Tallahassee, FL 32399
904-488-0484

FLORIDA VOCATIONAL ASSOCIATION (FVA)
1420 North Paul Russell Road
Tallahassee, FL 32399
904-878-6860

FLORIDA VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)
Florida Department of Education
Knott Building
Tallahassee, FL 32399
904-488-0484

## TRADE ORGANIZATIONS

This list contains trade associations and technical societies. Many offer training programs of some sort, either directly or through their member companies. Specific details should be requested in writing.

AMERICAN SOCIETY FOR LASER MEDICINE AND SURGERY, INC.
813 Second Street
Suite 200
Wausau, WI 54401
(715) 845-9283

INSTITUTE OF INDUSTRIAL ENGINEERS
25 Technology Park
Atlanta, GA 30092

LASER INSTITUTE OF AMERICA
5151 Monroe Street
Toledo, OH 43623

OPTICAL SOCIETY OF AMERICA
1816 Jefferson Place NW
Washington, DC 20036

SOCIETY OF MANUFACTURING ENGINEERS
One SME Drive
Dearborn, MI 48121
(313) 271-1500

SPIE-THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERS
P.O.Box 10
Bellingham, WA 98227-0010

State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

IE592 BK-91

# CAREER MERIT ACHIEVEMENT PLAN (CAREER MAP)

## LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY

**(0615.030401)**

STUDENT'S NAME

**State of Florida**

*An affirmative action/equal opportunity employer*

**DEPARTMENT OF EDUCATION**
Betty Castor, Commissioner of Education

**DIVISION OF VOCATIONAL, ADULT AND COMMUNITY EDUCATION**
Robert S. Howell, Director

**DEVELOPED BY:**
University of South Florida
Department of Adult and Vocational Education

**INDUSTRY-BASED PARTNERSHIP PROGRAMS:** The State of Florida is committed to the development of industry-based partnership programs, designed by education and industry to respond to industry's demand for a highly skilled work force.

## ACKNOWLEDGEMENTS

The curriculum for the Laser Electro-Optic Engineering Technology program was developed by the Florida Department of Education with assistance from representatives from industry and vocational education instructors.

For further information, contact
Bureau of Vocational Program and Staff Development
Division of Vocational, Adult, and Community Education
Department of Education
Knott Building
Tallahassee, FL 32399

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## THIS MERIT ACHIEVEMENT PLAN RECORDS THE LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY ACHIEVEMENTS OF:

**Student's Name** _____

**Student ID Number** _____

**Student's Address** _____

_____

**Initial Instructor** _____

**School** _____

**Date Started** _____

## PRIMARY JOB TITLE(S) FOR LASER ELECTRO-OPTIC ENGINEERING TECHNOLOGY

- Laser Engineering Technicians

Program completers qualify for the primary job title(s) listed above. Related job titles may be added based on those job titles found in industry and/or the Dictionary of Occupational Titles.

## OVERVIEW

This Career MAP includes the competencies required for entry into the field of laser electro-optic engineering. Business and industry representatives have recommended that students in this field master these competencies in order to become employable. Local education agencies (LEAs) may adapt these competencies to meet their workforce needs.

## PURPOSE OF THE MAP

The purposes of the MAP are: to display the student performance standards (SPS) required by the LEA and to document the level of achievement on student performance standards that the student demonstrates.

## HOW TO USE THE MAP

*Administrator and Instructor.* The administrator and instructor can use Career MAPs in curriculum planning, program updating and improvement and teacher recruitment, selection and updating. If the LEA changes or adds student performance standards, the revised or additional student performance standards should be included in the blank boxes that appear within each intended outcome or at the end of this MAP.

*Instructor.* The instructor can use Career MAPs to keep track of student progress on student performance standards. By periodically reviewing the ratings on student performance standards, the instructor can identify a student's strengths and weaknesses and, on that basis, identify the skills for which the student needs remedial instruction or advanced training. The MAP can also be useful in student counseling and evaluation.

*Co-op Instructor/Employer.* The employer who sponsors a co-op program should use the Career MAP for keeping a record of the student's performance on appropriate standards. The MAPs will also help the co-op instructor/employer in counseling and evaluating the student.

*Student.* The student may use the MAP to show potential employers the performance standards he or she has mastered. In order to present a complete record, the student should encourage the instructor/co-op employer to rate his or her level of achievement on all the appropriate student performance standards and to fill in the verification form/cooperative work experience page in the back of this MAP.

*Employer.* The MAP shows an employer the student performance standards mastered by the student (a prospective employee) and the proficiency level achieved on each student performance standard. This information can help the employer make decisions about hiring, job assignments and job-training needs.

## RATING STUDENT PERFORMANCE STANDARDS

*Performance Competencies.* Ratings on student performance standards should be based upon business/industrial performance standards. The evaluator observes and evaluates student performance as he or she would in the role of the employer or supervisor.

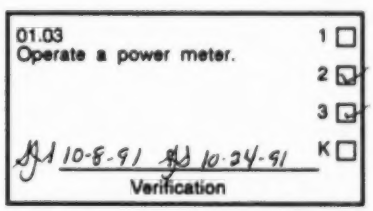
For each skill listed the learner receives a rating of 1, 2 or 3. Each rating indicates a particular level of achievement:

**1** = Learner demonstrates knowledge and understanding of this student performance standard, but is not yet able to apply that knowledge or understanding.

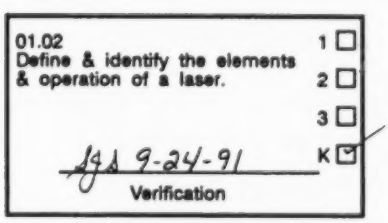
**2** = Learner performs this student performance standard satisfactorily with only periodic supervision.

**3** = Learner performs this student performance standard satisfactorily without supervision.

Whenever a performance standard is demonstrated, the instructor checks the appropriate rating box (1, 2 or 3) and initials and dates the verification line. If the student later demonstrates a higher level of achievement on a performance competency, the instructor checks the higher level and then enters his or her initials and the new date on the verification line, as shown in the following example:




*Knowledge Competencies.* For each SPS that is a knowledge competency only, with no manipulative skill involved, only one level of achievement is possible. If the student masters the competency, he or she receives a check in the bottom box ("K"), as shown below:




NOTE: A student performance standard without a checked rating indicates that the learner has not mastered the standard from lack of either ability, time, opportunity or need (the student's area of specialization may not have required it).

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## 01.0 DEMONSTRATE PROFICIENCY, IDENTIFICATION AND USE OF LASERS.

| | | |
|---|---|---|
| 01.01 Identify & apply laser safety practices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.02 Define & identify the elements & operation of a laser. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.03 Operate a power meter. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 01.04 Demonstrate proper cleaning techniques for optical material. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.05 Identify & utilize component supports. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.06 Analyze the use of filters & beam-splitters. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 01.07 Define & analyze the properties of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.08 Measure & analyze the emission & absorption of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 01.09 Define & analyze lasing action. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 01.10 Identify, analyze & define optical cavities & modes of oscillation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 02.0 DEMONSTRATE AND PRACTICE THE USE OF OPTICAL ELEMENTS.

| | | |
|---|---|---|
| 02.01 Describe & analyze temporal characteristics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.02 Describe & analyze spatial characteristics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.03 Define & analyze the characteristics of a gas laser. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

| | | |
|---|---|---|
| 02.04 Define laser classifications & characteristics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.05 Define reflection & refraction. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.06 Apply principles of reflection graphically & experimentally. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 02.07 Apply principles of refraction graphically & experimentally. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.08 Apply principles of imaging with a single lens graphically & experimentally. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 02.09 Apply principles of imaging with a multiple lens graphically & experimentally. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 02.10 Apply principles of the effect of F-stop & apertures graphically & experimentally. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 03.0 DEMONSTRATE AND ANALYZE WAVE OPTICAL SYSTEMS.

| | | |
|---|---|---|
| 03.01 Identify & analyze light sources & their characteristics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.02 Define & describe the quantities of radiometric & photometric in the radiation of energy/power. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.03 Describe & define the wave nature of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 03.04 Analyze reflection & refraction using the principles of the wave nature of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.05 Identify & apply the effects of propagation of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.06 Demonstrate the interference light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 03.07 Define & apply the principles of the diffraction of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.08 Demonstrate the polarization of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 03.09 Operate polarizers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

| | | |
|---|---|---|
| 03.10 Define & analyze the coupling of light into fiber optics. 1 2 3 K Verification | 03.11 Analyze the propagation of light in fiber optics. 1 2 3 K Verification | 03.12 Describe the construction of optical fibers. 1 2 3 K Verification |
| 03.13 Identify & describe the losses in fiber optics. 1 2 3 K Verification | 03.14 Identify the advantages & disadvantages of fiber optics. 1 2 3 K Verification | 1 2 3 K Verification |
| 1 2 3 K Verification | 1 2 3 K Verification | 1 2 3 K Verification |

## 04.0 PERFORM LASER TECHNOLOGY APPLICATIONS.

| | | |
|---|---|---|
| 04.01 Define & apply nondestructive testing techniques. 1 2 3 K Verification | 04.02 Define & apply range finding. 1 2 3 K Verification | 04.03 Define & apply alignment & angle testing. 1 2 3 K Verification |
| 04.04 Construct four types of interferometers. 1 2 3 K Verification | 04.05 Construct & use a holography system. 1 2 3 K Verification | 1 2 3 K Verification |
| 1 2 3 K Verification | 1 2 3 K Verification | 1 2 3 K Verification |
| 1 2 3 K Verification | 1 2 3 K Verification | 1 2 3 K Verification |

## 05.0 CALIBRATE, TROUBLESHOOT, AND ANALYZE LASER PERIPHERAL COMPONENTS.

| | | |
|---|---|---|
| 05.01 List the properties of different types of optical materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.02 Define & demonstrate the limitations of optical materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.03 Define & demonstrate windows & flats. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 05.04 Define & demonstrate mirrors & etalons. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.05 Apply & analyze prisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.06 Apply & analyze the use of lenses. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 05.07 Apply & analyze the use of gratings. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.08 Apply & define nonlinear materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 05.09 Apply beam expanders & spatial filters. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 06.0 DEMONSTRATE AND PRACTICE LASER ENERGY APPLICATIONS.

| | | |
|---|---|---|
| 06.01 Apply & define laser safety, hazards & evaluation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.02 Troubleshoot & analyze pulsed laser flashlamps & power supplies. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.03 Troubleshoot & use power sources for CW lasers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 06.04 Define & analyze the use of CW solid lasers-efficiency & cooling. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.05 Measure & record laser power & energy. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.06 Apply laser beam divergence & focusing. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

LASER ELECTRO-OPTIC ENGINEERING

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|---|---|---|
| 06.07 Troubleshoot & define optically pumped pulsed solid lasers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.08 Troubleshoot & define laser Q-switching. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 06.09 Apply & define semiconductor lasers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 07.0 ANALYZE, CONSTRUCT AND DEMONSTRATE LASER OPTICAL MEASUREMENTS.

| | | |
|---|---|---|
| 07.01 Operate & analyze electro-optic devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 07.02 Operate & analyze acousto-optic devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 07.03 Define mode-locking. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 08.0 DEMONSTRATE PROFICIENCY IN ANALYSIS AND EVALUATION OF WAVE OPTICAL SYSTEMS.

| | | |
|---|---|---|
| 08.01 Measure the imaging properties of single lenses. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.02 Measure the magnification of multiple lens systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.03 Adjust the telescope for collimation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 08.04 Measure & correct lens system for minimum aberration. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.05 Measure the effect of F-stops & apertures. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.06 Measure the properties of gratings. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

| | | |
|---|---|---|
| 08.07 Describe the fundamental characteristics of image erection systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.08 Apply the matrix method of ray tracing through optical systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.09 Analyze the effective use of filters & beam splitters. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 08.10 Test the stability of optical mounting methods. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 08.11 Measure light intensity in photometric units. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 09.0 DEMONSTRATE PROFICIENCY IN ANALYSIS, ASSEMBLY OF LASER COMPONENTS, & TEST BEAM CHARACTERISTICS.

| | | |
|---|---|---|
| 09.01 Identify & analyze light sources & their characteristics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.02 Define & describe the quantities of radiometric & photometric in the radiation of energy/power. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.03 Describe & define the wave nature of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 09.04 Demonstrate the effects of reflection & refraction. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.05 Demonstrate the effects of propagation of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.06 Demonstrate the interference light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 09.07 Demonstrate the diffraction of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.08 Distinguish between specular, diffuse & fresnel reflections. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.09 Demonstrate the use of polarizers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 09.10 Measure filter absorption & optical density. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.11 Observe & calculate (using several light sources) the wave length & frequency of prominent spectral lines. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.12 Assemble & align a HeNe laser resonator. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

| | | |
|---|---|---|
| 09.13 Measure beam diameter & divergence. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.14 Set up & operate a spectrometer. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.15 Demonstrate proper cleaning of an uncoated optical surface. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 09.16 Measure & diagram reflection characteristics of plan surfaces. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.17 Measure transmission & absorption of optical materials (propagation). 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.18 Analyze photodectors. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 09.19 Troubleshoot photodectors. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 09.20 Calibrate photodectors. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 10.0 DEMONSTRATE PROFICIENCY IN OPTICAL SYSTEMS, MAKING USE OF WAVE CHARACTERISTICS OF LIGHT.

| | | |
|---|---|---|
| 10.01 Measure & diagram reflection characteristics of spherical surfaces. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.02 Measure & diagram refraction characteristics of plan surfaces. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.03 Measure & diagram refraction characteristics of spherical surfaces. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 10.04 Demonstrate diffraction & interference. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.05 Demonstrate polarization characteristics of light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.06 Demonstrate the optical characteristics of prisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 10.07 Demonstrate the optical characteristics of windows. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.08 Demonstrate the fundamental characteristics of wedges. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 10.09 Measure the local length of spherical single lenses. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

| | | |
|---|---|---|
| 10.10 Demonstrate the optical path differences in thin films. 1 2 3 K _____ Verification | 10.11 Design & construct a laser-up collimator. 1 2 3 K _____ Verification | 10.12 Measure the wave length of basic lasers. 1 2 3 K _____ Verification |
| 10.13 Measure the temporal output of basic lasers. 1 2 3 K _____ Verification | 10.14 Measure the spatial output of basic lasers. 1 2 3 K _____ Verification | 10.15 Make a qualitative interpretation & assessment of the surface quality of a test optical surface. 1 2 3 K _____ Verification |
| 10.16 Set up & operate a monochromator. 1 2 3 K _____ Verification | 10.17 Set up & operate a Michelson interferometer. 1 2 3 K _____ Verification | 10.18 Set up & operate a Fabry-Perot interferometer. 1 2 3 K _____ Verification |
| 10.19 Set up & operate a Twyman-Green interferometer. 1 2 3 K _____ Verification | 10.20 Measure the longitudinal mode spacing of a TEMOoo laser, utilizing optical spectrum analyzer. 1 2 3 K _____ Verification | 1 2 3 K _____ Verification |
| 1 2 3 K _____ Verification | 1 2 3 K _____ Verification | 1 2 3 K _____ Verification |

## 11.0 DEMONSTRATE PROFICIENCY IN OPERATING OUTPUT BEAM CHARACTERISTICS OF VARIOUS GAS LASERS.

| | | |
|---|---|---|
| 11.01 Analyze power sources for CW lasers (gas & solid state). 1 2 3 K _____ Verification | 11.02 Troubleshoot power sources for CW lasers (gas & solid state). 1 2 3 K _____ Verification | 11.03 Analyze pulsed laser power supplies. 1 2 3 K _____ Verification |
| 11.04 Troubleshoot pulsed laser power supplies. 1 2 3 K _____ Verification | 11.05 Analyze energy transfer in laser systems (automatic, ionic & molecular). 1 2 3 K _____ Verification | 11.06 Calculate energy transfer in laser systems (atomic, ionic & molecular). 1 2 3 K _____ Verification |

| | | |
|---|---|---|
| 11.07 Analyze CW lasers. 1 2 3 K Verification | 11.08 Troubleshoot CW lasers. 1 2 3 K Verification | 11.09 Analyze pulsed lasers. 1 2 3 K Verification |
| 11.10 Troubleshoot pulsed lasers. 1 2 3 K Verification | 11.11 Demonstrate the effects of Q-switching. 1 2 3 K Verification | 11.12 Demonstrate the use of autocollimators. 1 2 3 K Verification |
| 11.13 Demonstrate Q-switching methods (dye, EO, AO & mechanical). 1 2 3 K Verification | 11.14 Demonstrate use of modulators & deflators. 1 2 3 K Verification | 11.15 Calculate/measure percentage of transmission of CW $CO_2$ laser beam through uncoated GE lens. 1 2 3 K Verification |
| 11.16 Combine helium, nitrogen & carbon dioxide in $CO_2$ laser & determine power output for various mixture ratios. 1 2 3 K Verification | 1 2 3 K Verification | 1 2 3 K Verification |
| 1 2 3 K Verification | 1 2 3 K Verification | 1 2 3 K Verification |

## 12.0 DEMONSTRATE PROFICIENCY IN SOLID-STATE LASERS IN VARIOUS OPERATIONAL MODES.

| | | |
|---|---|---|
| 12.01 Analyze & troubleshoot flashlamp ignition & simmer circuits. 1 2 3 K Verification | 12.02 Determine beam convergence as function of lamp current to produce graph of lamp current vs. Nd:YAG laser. 1 2 3 K Verification | 12.03 Demonstrate Q-switching methods. 1 2 3 K Verification |
| 12.04 Demonstrate frequency doubling in Nd:YAG laser. 1 2 3 K Verification | 12.05 Measure output beam characteristics of a pulsed Nd:YAG laser. 1 2 3 K Verification | 12.06 Design & construct a breadboard pulse-forming network containing a gas-filled flashlamp. 1 2 3 K Verification |

| | | |
|---|---|---|
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |

## 13.0 DEMONSTRATE PROFICIENCY IN LASER SYSTEMS DESIGNS APPROPRIATE TO ASSIGNED APPLICATIONS.

| | | |
|---|---|---|
| 13.01<br>Choose the best laser to use for a given material processing application.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.02<br>List the variables that determine the speed & quality of material procession applications.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.03<br>Measure & adjust the output characteristics of laser beams.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 13.04<br>Describe the alignment procedure of an articulated arm beam delivery system.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.05<br>Draw a schematic illustration of the optical system of a micromanipulator used to position a $CO_2$ laser beam on a medical target.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.06<br>Demonstrate the effect on a tissue target of varying the focal length of an objective lens.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 13.07<br>Determine atmospheric attenuation factors, & the amount of laser power-energy needed to transmit a laser beam over a given range through specified atmospheric conditions.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.08<br>List 5 major differences & the same number of similarities of Nd:YAG lasers used for each of the three major applications.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 13.09<br>List 5 major differences & the same number of similarities of $CO_2$ lasers used for each of the three major applications.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 13.10<br>Describe the difference between target designators & rangefinders.<br>1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |

## 14.0 DEMONSTRATE PROFICIENCY PLANNING AND DOCUMENTING A LASER-ORIENTED PROJECT.

| | | |
|---|---|---|
| 14.01 Demonstrate medical laser safety. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 14.02 Demonstrate ANSI laser safety standards. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 14.03 Demonstrate CDRH laser safety standards. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 14.04 Perform safety assessment of a facility which uses laser devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 0.0 DEMONSTRATE EMPLOYABILITY SKILLS.

| | | |
|---|---|---|
| 0.01 Conduct a job search. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.02 Secure information about a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.03 Identify documents that may be required when applying for a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 0.04 Complete a job application form correctly. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.05 Demonstrate competence in job interview techniques. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.06 Identify or demonstrate appropriate responses to criticism from employer, supervisor or other persons. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 0.07 Identify acceptable work habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.08 Demonstrate knowledge of how to make job changes appropriately. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 0.09 Demonstrate acceptable employee health habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

## 00.0 DEMONSTRATE AN UNDERSTANDING OF ENTREPRENEURSHIP.

| | | |
|---|---|---|
| 00.01 Define entrepreneurship. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 00.02 Describe the importance of entrepreneurship to the American economy. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 00.03 List the advantages & disadvantages of business ownership. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 00.04 Identify the risks involved in ownership of a business. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 00.05 Identify the necessary personal characteristics of a successful entrepreneur. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 00.06 Identify the business skills needed to operate a small business efficiently & effectively. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |
| 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification | 1 ☐ 2 ☐ 3 ☐ K ☐ Verification |

P.O.W.E.R. SKILLS (PRINCIPLES OF WORK ENVIRONMENT READINESS)

## 000.0 COOPERATIVE WORK EXPERIENCE COMPETENCIES.

| | | |
|---|---|---|
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |
| 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification | 1 ☐<br>2 ☐<br>3 ☐<br>K ☐<br>Verification |

## VERIFICATION

The instructor should verify the level of mastery achieved by the student by initialing the competency box each time the student masters a competency. Later, if the student achieves a higher degree of mastery of a competency, the higher degree should be recorded and verified by the instructor.

INSTRUCTOR SHOULD SIGN FULL NAME AND SCHOOL NAME AND ADDRESS IN THE SPACE BELOW.

| | |
|---|---|
| Verification | Signature |
| | Title |
| | School Name |
| | School Address |

| | |
|---|---|
| Verification | Signature |
| | Title |
| | School Name |
| | School Address |

| | |
|---|---|
| Verification | Signature |
| | Title |
| | School Name |
| | School Address |

## COOPERATIVE WORK EXPERIENCE

In addition to classroom training and laboratory performance identified on the Career MAP, this student has participated in cooperative work experience with employers as shown below:

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

## NOTES

This section of the MAP is provided so the instructor, employer, or student may list additional qualifying statements or other pertinent information. All comments should be initialed for verification.

State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

IE591 BK-91